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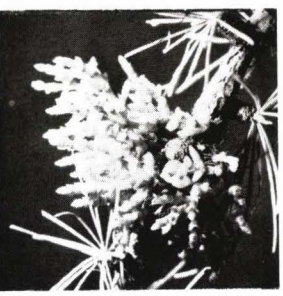

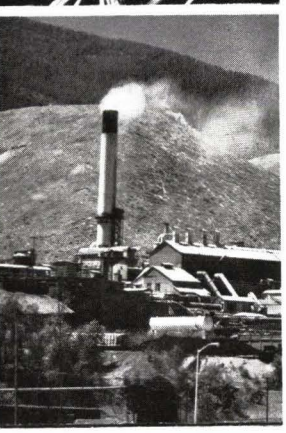

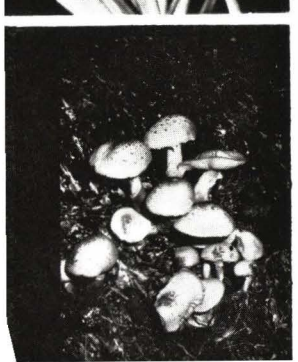

FOREST INSECT & DISEASE MANAGEMENT

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EVALUATION OF A MOUNTAIN PINE BEETLE INFESTATION, JACK CREEK DRAINAGE, MADISON DISTRICT, BEAVERHEAD NATIONAL FOREST, MONTANA, 1976

by

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ABSTRACT

Mountain pine beetle populations developed to epidemic level in lodgepole pine stands in 1973. Approximately 426,355 trees were killed on 3,433 hectares in 1976. Infestations are expected to intensify in areas of current infestation and develop in uninfested stands. It is predicted that 1,722,288 trees will be killed in 1977. Salvage logging of infested trees and silvicultural management to reduce average stand diameter below 20.3 cm d.b.h. are recommended.

INTRODUCTION

A mountain pine beetle, *Dendroctonus ponderosae* Hopk., outbreak developed to epidemic status in lodgepole pine, *Pinus contorta* var. *latifolia* Engelm., stands in the Jack Creek drainage, 19 km east of Ennis, Montana, in 1976. (Figure 1) Scattered groups of infested trees were detected in 1973. In 1974, over 1,800 infested trees occurred in mixed stands on 316 ha of Burlington Northern and U.S. Forest Service land (Hamel and Dooling 1975). Aerial insect and disease detection surveys in 1975 and 1976 showed an annual increase in number of faders and hectares infested. Because of these increases, an evaluation was conducted to determine infestation boundaries, estimate tree losses, and measure buildup ratios from 1973 through 1976.

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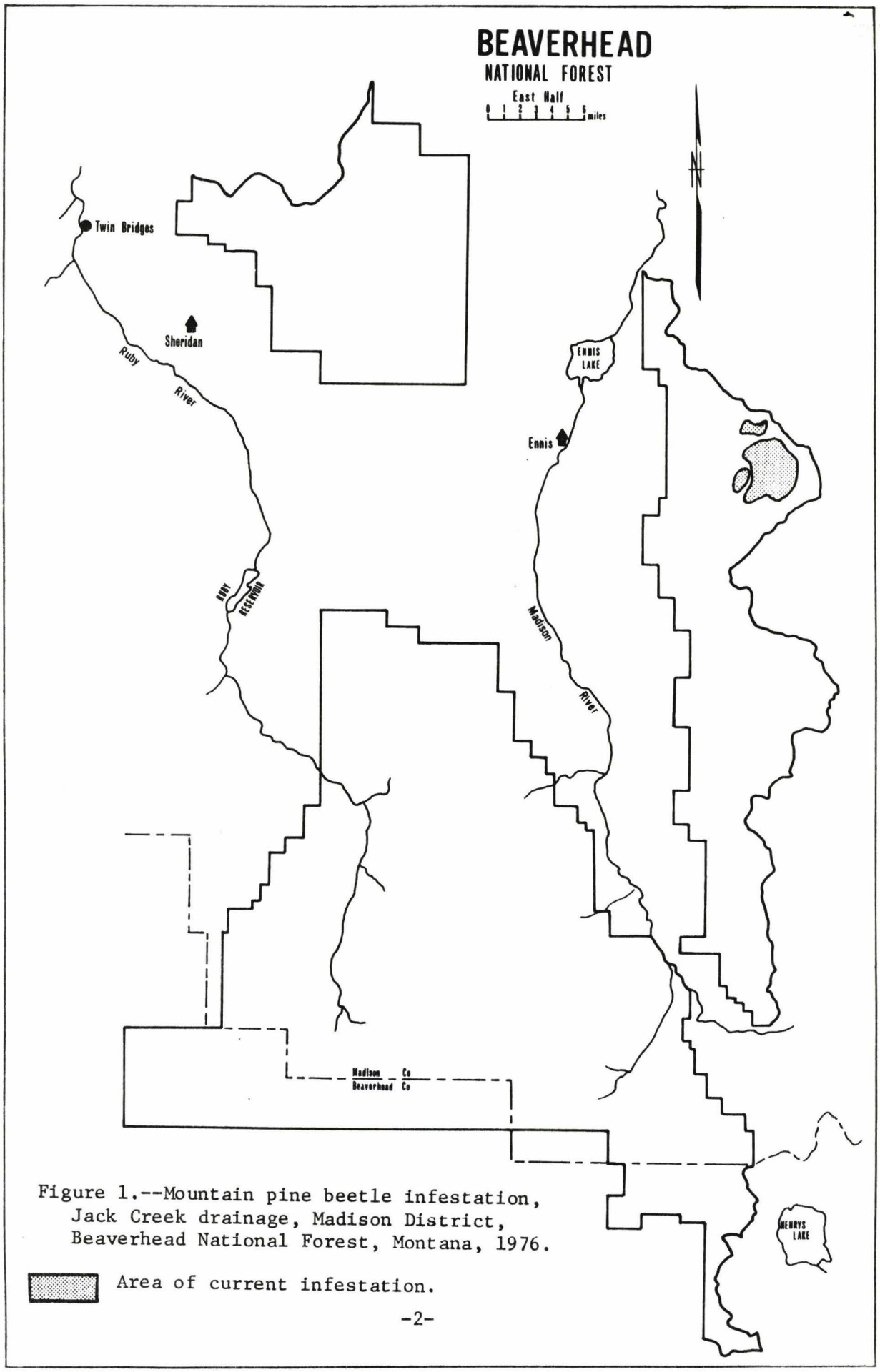

Figure 1.--Mountain pine beetle infestation, Jack Creek drainage, Madison District, Beaverhead National Forest, Montana, 1976.

Area of current infestation.

METHODS

Ground surveys were conducted in December. Three side drainages of Jack Creek were evaluated: Hammond, Lower Wickiup, and Wickiup Creeks. Within each infested area, ten 1/25-ha plots were established on line at 100 m intervals. Hypsometers were used to determine trees to be tallied within plot boundaries. All green trees were recorded by species and measured by diameter at breast height (d.b.h.). Estimates of phloem thickness for each diameter class were obtained from bark samples removed with a hand axe from opposite sides of two trees in each d.b.h. size class. Phloem thickness was measured to the nearest 0.25 mm using a steel ruler.

In addition, twenty 1/10-ha plots were taken in each area to determine level of beetle infestation and buildup ratios.

Infested trees in each plot were recorded by species, d.b.h., and categorized into the following classes:

0 = green, uninfested.
1 = 1976 attack; green or partially faded foliage, brood and blue stain present.
2 = 1975 attack; red foliage, brood emerged.
3 = 1974 or prior attack; majority of needles dropped.
4 = unsuccessful attack or pitchout, brood and blue stain absent.

RESULTS

The coniferous stands surveyed are mixed with lodgepole pine predominating (Table 1).

Table 1.--Green stand data, Jack Creek subdrainages, Beaverhead National Forest, 1976.

Location	Tree species*	Percent of stand	Trees per ha
Hammond Cr.	LPP	64.4	161
	DF	30.7	77
	S	5.0	12
L. Wickiup Cr.	LPP	69.3	254
	DF	12.9	47
	SAF	14.7	54
	S	3.1	10
Wickiup Cr.	LPP	84.6	211
	DF	12.0	30
	SAF	3.3	8

* LPP, lodgepole pine; DF, Douglas-fir; SAF, subalpine fir; S, spruce.

Habitat type in the infested areas is *Abies lasiocarpa/Vaccinium globulare*, and occurs at elevations from 1,900 to 2,600 meters.

Numbers of 1976 infested trees ranged from a low of 64.2 per ha in Lower Wickiup Creek to 101.3 and 207.1 per ha in Hammond and Wickiup Creeks respectively (Table 2).

Table 2.--Summary of infested stands surveyed, Beaverhead National Forest, 1976.

Area	Infested trees per ha	Mean d.b.h. of attacked trees(in cm)	Percent of phloem samples ≥0.25 cm	Buildup ratio from 1975
Hammond Cr.	101.3	33.5	32.2	1:13.1
L. Wickiup Cr.	64.2	32.3	20.2	1:1.7
Wickiup Cr.	207.1	34.0	36.8	1:8.7

Buildup ratios of old (1975) to newly attacked trees ranged from 1:1.7 in Lower Wickiup to 1:13.1 in Hammond Creek. Mean buildup ratio was 1:7.9 for areas surveyed. Tree mortality in 1976 occurred in all diameter classes from 15.2 to 55.9 cm with greatest mortality in the 22.9 to 45.7 cm d.b.h. size classes. Approximately 26 percent of the trees attacked in 1976 had mean phloem thickness $\geq$ 0.25 cm, and nearly 25 percent of attacked trees were classed pitchouts. Approximately 88 percent of the infested trees are 25.4 cm d.b.h. or larger. Successfully attacked trees (1976) had mean diameter of 33.2 cm and mean phloem thickness of 0.20 cm. Mean diameter of the remaining lodgepole pine within the infested area is approximately 24.6 cm with a mean phloem thickness of 0.19 cm.

DISCUSSION

The mountain pine beetle outbreak in the Jack Creek drainage began in 1973 and by 1976 the area of infestation increased more than tenfold. Currently, 3,433 ha are heavily infested. Infested trees per ha decreased from 33.6 in 1974 to 20.7 in 1975 and sharply increased to 124.0 in 1976. The current buildup ratio of 1:7.9 is a strong indicator that the infestation will continue at epidemic level.

Infestations of mountain pine beetle usually develop in stands 80 years or older, containing many trees 25.4 cm d.b.h. and larger. Under outbreak conditions, stand depletion can increase 4 to 9 percent with each

increase in diameter class above 15.2 cm d.b.h. (Safranyik et al. 1974). Epidemic conditions will probably continue until larger diameter trees with phloem $\geq$ 0.25 cm are killed, resulting in an average diameter of the residual stand usually below 20.3 cm d.b.h.

Number of trees killed during infestations is dependent on beetle population density, which is influenced by phloem thickness, tree diameter, stand density, and habitat type (Cole 1973; Safranyik et al. 1974). Phloem thickness is considered the principal factor regulating brood production (Amman 1969). Studies by Amman (1969; 1972) have shown brood production to be positively correlated with phloem thickness and phloem thickness positively correlated with tree diameter.

Amman et al. (In Press) developed a hazard rating system for mountain pine beetle in lodgepole pine stands which includes such factors as; (1) age, (2) elevation, and (3) average d.b.h. for the stand. Stands in general must be $\geq$ 80 years of age, located at an elevation where climate is favorable for beetle brood development, and the average d.b.h. of the stand for trees 12.7 cm and larger must exceed 20.3 cm d.b.h. These factors and buildup ratios were used in hazard rating stands evaluated in the Jack Creek drainage.

By multiplying the following factors, 1 = low, 2 = moderate, and 3 = high for age, elevation, and average d.b.h., a susceptibility rating for lodgepole pine in the stand is obtained.

Based on this hazard rating system, stands surveyed were rated as shown in Table 3.

Table 3.--Hazard rating for lodgepole pine stands surveyed, Madison District, Beaverhead National Forest, 1976.

Area	Age	Rating	Elevation in meters	Rating	Mean d.b.h. in cm	Rating	Overall rating	Predicted trend
Hammond Cr.	100+	(3)	1,981	(3)	33.5	(3)	(27)	High
Lower Wickiup Cr.	100+	(3)	2,073	(3)	32.3	(3)	(27)	High
Wickiup Cr.	100+	(3)	2,313	(3)	34.0	(3)	(27)	High

Based on buildup ratios from 1974 through 1976, and on the formula

$Y' = y + bx$ (Baker 1968) where

Y' = the potential cumulative number of trees killed predicted through next year (1977).
y = the cumulative number of trees killed through this year.
x = number of trees killed this year (1976).
x_1 = number of trees killed last year (1975).
$b = \frac{x}{x_1}$

it is predicted that 1,722,288 trees will be killed in the Jack Creek drainage in 1977. This will bring the cumulative total of trees killed by the mountain pine beetle to more than 2 million since the infestation began in 1973.

MANAGEMENT ALTERNATIVES

Stands that show a high probability for potential and subsequent loss to the beetle can be managed in several ways, depending upon land use objectives (Amman et al. In Press).

Where timber values are primary

1. Recognizing that the beetle concentrates heavily on large diameter, older trees (80+ years), continuous lodgepole pine forests can be broken up into small clearcuts resulting in different age and size classes, thereby reducing the area likely to be infested at any one time. Then when a stand approaches or matures to high risk conditions, all trees in specific areas could be harvested.

2. Since the beetle shows preference for large diameter trees, selective cuts directed at these trees will greatly reduce infestation potential. Removal of trees 20.3 cm d.b.h. and larger would "beetle proof" most stands. When partial cuts are prescribed, the residual stand should be numerically adequate and physically vigorous to maintain stocking and stand productivity.

Partial cutting prescriptions may not be the best method to manage mountain pine beetle in understocked and overstocked stands, particularly if trees are on high productive sites and growing well. In such stands a high proportion of trees in the diameter classes $<$ 20.3 cm d.b.h. may have thick phloem. In those trees beetle production may continue to be high enough to maintain the infestation at epidemic level, resulting in considerable tree mortality. Clearcutting and regenerating the stand may be the best method of managing high risk understocked or overstocked stands on high productive sites.

3. Another alternative for stands that are particularly susceptible to damage by this beetle is to favor nonhost trees such as Douglas-fir, *Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco. Data shows that the beetle infests lodgepole pine in mixed species forests just as readily as in pure forests. However, in a mixed species forest, the presence of nonhost trees will result in greater residual stocking should an outbreak occur and develop to epidemic level. In addition, land managers must realize that if they select to convert lodgepole pine forests to other species, they can eventually expect losses by other insects.

The most effective method of managing mountain pine beetle, and the one recommended for the Jack Creek drainage, is through a combined program of logging infested trees and silvicultural treatment to remove or reduce the inventory of large diameter, thick phloemed, highly susceptible trees. Beetle populations are expected to remain at epidemic levels until the average tree diameter of the stand is reduced below 20.3 cm d.b.h. Infestation is expected to develop in uninfested, unmanaged susceptible stands in other drainages within 2 years.

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